Problem1:

For this problem, we are going to utilize the methods to calculate the VaR based on the prior weeks' notes on the three different distribution methods, and also using the ES we learned from this week, which is expected value of Profit and Loss given the Loss is beyond VaR to get the results as following:

Normal Distribution with an Exponentially Weighted Variance:

Value at Risk (VaR): -0.09028950269062073

Expected Shortfall (ES): 0.11410650846697049

MLE fitted T distribution

Value at Risk (VaR) using T-distribution: -0.0764758759203622

Expected Shortfall (ES) using T-distribution: -0.11321759703671269

Historic Simulation

Value at Risk (VaR) using Historical Simulation: -0.075861511162783

Expected Shortfall (ES) using Historical Simulation: -0.11520303685782037

As we can see from the results above and compare the absolute values, we can see that though the results are pretty close to each other.

VaR(EWMA) > VaR(MLE T distribution) > VaR(Historic Simulation), this is because that exponentially weighted variance approach adjusted the recent volatility but still have a thin-tailed normal distribution around the mean, which is conservative but might overstate some losses. In contrast, the T distribution has a fatter tail, which allows the method to provide more accurate reflection of potential extreme cases without overestimate the risks, same for the historic simulation. Still, it counted more of the actual historical data to reflect the market.

ES(Historic Simulation) > ES(EWMA) > ES(MLE T distribution). The historic simulation method reflects the actual tail events more accurately, so best captures the real world's loss expectations, resulting a larger ES than other methods, the EWMA method is less sensitive to the extreme events and underestimates the depth of the tail losses.

Problem2:

For this problem, we are going to fit Generalized T models to stocks in portfolios A and B, and fit a normal distributions to stocks in portfolio C and use copula simulation to get the simulated PnLs, then get the VaR and ES based on the same methodology we applied in the first problem.

The results from this week are as below:

Portfolio A VaR: $4779.29 and VaR_decimal: 0.01263

Portfolio A ES: $6653.99 and ES_decimal: 0.01758

Portfolio B VaR: $4010.80 and VaR_decimal: 0.01050

Portfolio B ES: $5815.93 and ES_decimal: 0.01523

Portfolio C VaR: $3579.08 and VaR_decimal: 0.01176

Portfolio C ES: $4527.63 and ES_decimal: 0.01488

Portfolio Total VaR: $12013.33 and VaR_decimal: 0.01128

Portfolio Total ES: $16192.12 and ES_decimal: 0.01521

Now we apply the same codes from last week and get the results below:

Portfolio A EWMA VaR in $ (Arithmetic Returns): 6214.882145710423

Portfolio B EWMA VaR in $ (Arithmetic Returns): 6628.232740705449

Portfolio C EWMA VaR in $ (Arithmetic Returns): 4916.82753006697

Total Portfolio EWMA VaR in $ (Arithmetic Returns): 17238.033245865045

As we can see from the results above, we can see that the VaR for EWMA from last week are all higher for all the portfolios than the T and normal distributed methods' results, which might because it captures the recent data and adjust to the volatility quickly from the recent changes, and also beneficial for the short-term risk assessments. While for the copula-based T and normal distribution approach, it provides more moderate estimates.